OVERWINTERING IN THE BIRCH APHID, *EUCERAPHIS PUNCTIPENNIS*

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Introduction

The birch aphid, *Euceraphis punctipennis* (Zetterstedt) lives on birch (*Betula pendula* Roth or *B. pubescens* Ehrh.) throughout the year. The first (fundatrix) generation hatches from the egg in early spring and gives rise to a series of parthenogenetically reproducing generations during the summer. In autumn, sexual males and females (oviparae) are produced which mate and the overwintering eggs are laid. It is generally supposed that aphid oviparae lay their eggs quickly after mating and then soon die (Blackman, 1974), since leaf fall or early frosts will result in loss of food supply and death. *E. punctipennis*, however, is a relatively large aphid which can feed on small twigs as well as leaves (Stroyan, 1977) and thus the apparent loss of food supply to this aphid in autumn may not be a problem. This study was therefore undertaken to investigate the occurrence of birch aphid oviparae in autumn, during and after leaf fall. The winter of 1988–89 was exceptionally mild in southern Britain and this provided an excellent opportunity to follow the abundance of this aphid during an unusual winter.

Materials and methods

Five *B. pendula* saplings were selected at random from a group of eight growing in grassland at Silwood Park, Berkshire. One hundred buds were selected randomly from the five trees, the number of buds on each tree being decided by a random number table. Buds were examined *in situ* and the number of birch aphid oviparae and eggs associated with the buds recorded. Eggs when freshly laid are yellow, but soon darken to black if fertile (Blackman, 1974), making them easily seen. This method has been shown to be reliable for counts of aphid eggs in the field (Leather & Lehti, 1981). Sampling began on 5.x.1988 and was continued weekly until the first fundatrix was found in spring 1989. Daily temperature recordings were taken from the Silwood Park weather station.

Results

The numbers of oviparae associated with 100 buds are shown in Figure 1. Oviparae were found for a considerable period after leaf fall, the last individual being found on 18.i.1989. Aphid mortality occurred primarily in late October and again in late November. The daily minimum temperature is also given in the figure and it can be seen that some oviparae survived the cold spell during late November, despite temperatures as low as −5.3°C.

The numbers of eggs recorded on 100 buds are also shown in Figure 1. Egg numbers reached a peak in late October thereafter fluctuating around 70 eggs per 100 buds. Freshly laid eggs were found until 11.i.1989, indicating that the oviparae remaining were still actively ovipositing. The first fundatrices were found on 3.ii.1989.

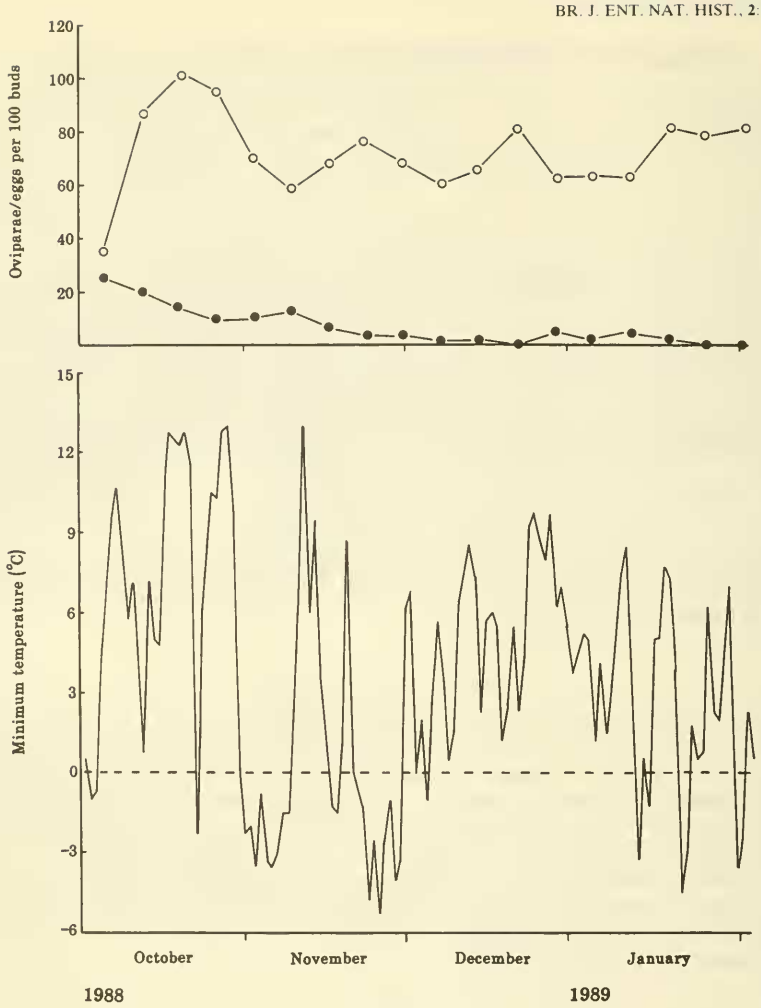

Fig. 1. Numbers of birch aphid oviparae (●) and eggs (○) per 100 buds and daily minimum temperature at Silwood Park, Berkshire, during the winter of 1988–1989.

Discussion

These results demonstrate that oviparae of the birch aphid are able to survive on birch trees long after leaf falls. Aphids were observed feeding on the young twigs and it appears that these provide a suitable food source, enabling egg laying to be prolonged late into the autumn. The fact that freshly laid eggs were found in the middle of January demonstrates this, although it has not been shown that these eggs were fertile. Dixon (1987) has proposed that since egg laying ends the aphid's population growth, this event should be postponed as late as possible in a season. For most species this means just before leaf fall, because the oviparae can develop and feed on the senescing leaves, which in late autumn provide a rich food supply (Dixon, 1985). In the case of the birch aphid it appears that the change to sexual morphs could

take place later in the season than most other aphid species. This would allow the final parthenogenetic generations the opportunity to develop on the nitrogen-rich leaves, since the oviparae are able to feed and survive on the twigs.

Fundatrices of *E. punctipennis* always hatch very early in the year. In this study they were recorded during the first week of February, and this is not unusual for Silwood Park (Gange unpublished observations). The reason for hatching so early is that the offspring of the fundatrix generation are able to feed on the exceptionally good food supply provided by the very youngest leaves. The fundatrices have to feed on the unopened buds and this means that there must be a very heavy mortality due to birds, wind and rain, as has been shown for the sycamore aphid, *Drepanosiphum platanoidis* (Schrank) which also hatches in February (Dixon 1976). In the case of the birch aphid it appears that this mortality may be offset to a certain extent by the fact that the autumnal generations may be able to postpone sexual production and that ovipara life may be long, due to twig-feeding. In addition, it appears that unless late autumn temperatures are particularly severe, this is unlikely to be a significant cause of mortality. Sexual production in aphids is generally controlled by photoperiod and affected by temperature (Dixon 1985). It would be worth determining the critical photoperiod for the birch aphid and whether this may be affected by mild autumnal weather.

The winter of 1988–89 was exceptionally mild, as shown by the fact that a normally diapausing aphid, *Macrosiphum rosae* (L.) was reported to be actively increasing in numbers on 20.i.1989 (Kirkman, 1989). Since it appears that prolonged periods of cold may seriously affect survival of the birch aphid, it may be that in a more 'normal' winter ovipararae would not be able to survive as long as has been reported here. The rapid decline in egg and ovipara numbers in late October is typical of winter mortality patterns in aphids and is a likely result of predation by anthocorid bugs, before their hibernation (Gange & Llewellyn, 1988). Other environmental factors such as wind and rain will also reduce egg and ovipara survival, and this winter was also rather dryer than usual (Silwood Park meteorological data). However, these results demonstrate that in very mild winters, the birch aphid can survive in the active form for up to 11 months of the year. The gap between the last recorded ovipara and the first fundatrix was only 16 days in this study and a more intensive sampling programme may have revealed a smaller interval still.

References

Blackman, R.L. 1974. *Invertebrate types. Aphids.* 175 pp. London: Ginn & Co. Ltd.

Dixon, A.F.G. 1976. Factors determining the distribution of sycamore aphids on sycamore leaves during summer. *Ecol. Entomol.* **1**: 275–278.

Dixon, A.F.G. 1985. *Aphid ecology*. 157 pp. Glasgow & London: Blackie.

Dixon, A.F.G. 1987. Seasonal development in aphids. In *Aphids their biology, natural enemies and control*. vol A. eds A.K. Minks & P. Harrewijn, Amsterdam: Elsevier, 315–320.

Gange, A.C. & Llewellyn, M.J. 1988. Egg distribution and mortality in the alder aphid, *Pterocallis alni*. *Ent. Exp. Appl.* **48**: 9–14.

Kirkman, E. 1989. Letter to *The Times*, no. 63,300, p. 13. January 25th 1989.

Leather, S.R. & Lehti, J.P. 1981. Abundance and survival of eggs of the bird cherry-oat aphid, *Rhopalosiphum padi* in southern Finland. *Ann. Ent. Fenn.* **47**: 125–130.

Stroyan, H.L.G. 1977. Homoptera Aphidoidea Chaitophoridae and Callaphididae. *Handbk Ident. Br. Insects* 2 (4a).